Seasonal and spatial variation of PM_1 organic tracers in densely populated Mediterranean urban areas: Barcelona vs. Madrid

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A comprehensive PM1 aerosol characterization was conducted within the AEROTRANS project. About 100 organic tracer compounds were analyzed in PM_1 filter extracts that were sampled from 2010 to 2012 in busy streets in the urban centres of Madrid (700 m.asl) and Barcelona (20 m.asl) (Spain), at ground-level and at 40 m.agl (N=57). Both urban areas have intensive traffic and a Mediterranean climate, although Madrid is continental and Barcelona is coastal. Summer and winter season was sampled, as well as night- and daytime, in order to distinguish possible seasonal and diurnal variation in organic tracer composition and concentrations.

Primary organic tracers for traffic and dust were 2 times higher at ground-level, with a daytime maximum, and generally 2 times higher concentrations in winter.

No significant differences were observed between ground-level and altitude measurements for secondary organic carbon (SOC) tracers, from biogenic origin (isoprene and pinene) and anthropogenic origin, suggesting that many of these products are related to regional air mass circulation and relatively stable in the urban atmosphere. However, relationships between specific biogenic tracers could be explained by the abundance of oxidants in the urban atmosphere, such as the relationship between isoprene SOCs and NOx (Figure 1). The biogenic SOC concentrations were about 10 times higher in summer than in winter. Largest differences were observed for isoprene SOC tracers (Figure 2).

Organic tracers for biomass burning increased by a factor of ~7 in both sites during the winter. There was more discrepancy in the concentration between ground-level and altitude, suggesting the presence of local sources or less atmospheric stability for these compounds. However, the good correlations between biomass tracers from different 'families' (e.g. acids and saccharides) suggested that nearby sources were responsible for this variation. A summer-time 2012 PM-event in Barcelona was directly linked to the impact of a sever wild-fire 100 km to the north of the city. All biomass organic tracers increase a factor ~100 in the 12-hour sample, while levels 'normalized' to background concentrations in the sample afterwards.

Despite the different geographical locations (continental vs. coastal), Madrid and Barcelona exhibit very similar compositions and concentrations of organic tracers for biogenic and anthropogenic SOC as well as for biomass burning. Larger differences were observed for primary organics, such as primary sugars and fatty acids (figure 2.) which were all higher in Barcelona and could be related to more humid atmosphere of Barcelona compared to Madrid.

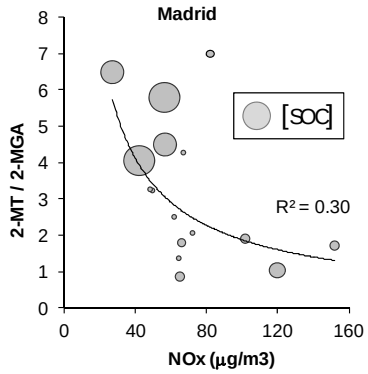

Figure 1. 2-methyltetrols-to-2-methylglyceric acid ratios vs. NOx concentrations in Madrid in relation with isoprene SOC.

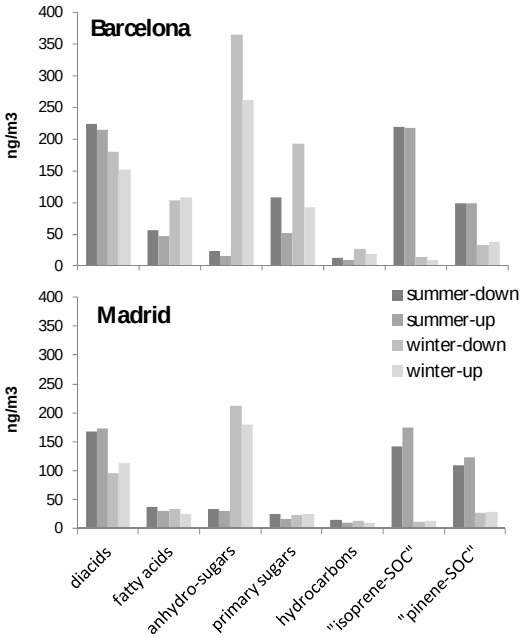

Figure 1. Concentrations of organic tracers in PM1 from Barcelona and Madrid sampled at ground-level (down) and 40 m.agl (up).

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